

U.S. Patent Application Serial No. 10/053,712
Amendment dated July 29, 2004
Reply to Office Action of March 26, 2004

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently amended): A semiconductor device comprising:

a first semiconductor layer formed [[on]] over a semiconductor substrate;

an outgoing base electrode formed [[on]] over the first semiconductor layer with an insulation film therebetween;

a base layer formed in a base region on the first semiconductor layer, covering a side surface of the outgoing base electrode, connected to the outgoing base electrode at [[a]] the side surface of the outgoing base electrode, and formed of silicon germanium containing carbon; and

a second semiconductor layer formed on the base layer,

wherein only the base layer is connected to the first semiconductor layer in the base region.

Claim 2 (Currently amended): A semiconductor device comprising:

a first semiconductor layer formed [[on]] over a semiconductor substrate;

an outgoing base electrode formed [[on]] over the first semiconductor layer;

a base layer formed in a base region on the first semiconductor layer, connected to the outgoing base electrode, and formed of silicon germanium containing carbon; and

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a second semiconductor layer formed on the base layer,
the outgoing base electrode and the base layer are formed continuous to each other,
wherein only the base layer is connected to the first semiconductor layer in the base region.

Claim 3 (Original): A semiconductor device according to claim 1, wherein
the base layer contains carbon by 0.01% to 6%.

Claim 4 (Original): A semiconductor device according to claim 2, wherein
the base layer contains carbon by 0.01% to 6%.

Claim 5 (Currently amended): A semiconductor device comprising:
a first semiconductor layer formed [[on]] over a semiconductor substrate;
an outgoing base electrode formed [[on]] over the first semiconductor layer with an insulation
film therebetween;
a base layer formed on the first semiconductor layer, covering a side surface of the outgoing
base electrode, connected to the outgoing base electrode at [[a]] the side surface of the outgoing base
electrode, and formed of silicon germanium containing carbon; and
a second semiconductor layer formed on the base layer,

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wherein a dopant concentration of the base layer at the part connected to the outgoing base electrode is higher than a dopant concentration of the base layer immediately below the second semiconductor layer.

Claim 6 (Currently amended): A semiconductor device comprising:
a first semiconductor layer formed [[on]] over a semiconductor substrate;
an outgoing base electrode formed [[on]] over the first semiconductor layer;
a base layer formed on the first semiconductor layer, covering a side surface of the outgoing base electrode, connected to the outgoing base electrode at the side surface of the outgoing base electrode, and formed of silicon germanium containing carbon; and
a second semiconductor layer formed on the base layer,
the outgoing base electrode and the base layer are formed continuous to each other,
wherein a dopant concentration of the base layer at the part connected to the outgoing base electrode is higher than a dopant concentration of the base layer immediately below the second semiconductor layer.

Claim 7 (Original): A semiconductor device according to claim 1, wherein
side-etching of an insulation film immediately below the outgoing base electrode is below 0.1
μm.

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Claim 8 (Original): A semiconductor device according to claim 2, wherein side-etching of an insulation film immediately below the outgoing base electrode is below 0.1 μm .

Claim 9 (Original): A semiconductor deice according to claim 1, wherein the base layer is projected upward beyond the upper surface of the outgoing base electrode by above 0.02 μm .

Claim 10 (Original): A semiconductor deice according to claim 2, wherein the base layer is projected upward beyond the upper surface of the outgoing base electrode by above 0.02 μm .

Claim 11 (Original): A semiconductor device according to claim 1, wherein the first semiconductor layer is a collector layer; and the second semiconductor layer is an emitter layer.

Claim 12 (Original): A semiconductor device according to claim 2, wherein the first semiconductor layer is a collector layer; and

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the second semiconductor layer is an emitter layer.

Claim 13 (Currently amended): A method for fabricating a semiconductor device comprising the steps of:

forming a first semiconductor layer over a semiconductor substrate;

forming an insulation film on the first semiconductor layer;

forming on the insulation film an outgoing base electrode with an opening reached to the first semiconductor layer formed on a first semiconductor layer formed on a semiconductor substrate;
[[and]]

forming a base layer of silicon germanium containing carbon at least in the opening, the base layer covering a side surface of the outgoing base electrode, only the base layer being connected to the first semiconductor layer in a base region; and

forming a second semiconductor layer on the base layer.

Claim 14 (Currently amended): A method for fabricating a semiconductor device according to claim 13, wherein

the step of forming the base layer includes the step of forming a carbon-content silicon germanium layer in the opening and [[on]] over the outgoing base electrode; the step of burying a mask material in the opening with the carbon-content silicon germanium layer; and the step of etching the carbon-content silicon germanium layer with the mask material as a mask.

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Claim 15 (Currently amended): A method for fabricating a semiconductor device comprising the steps of:

forming a base layer of silicon germanium containing carbon and an outgoing base electrode connected to the base layer [[on]] over a first semiconductor layer formed [[on]] over a semiconductor substrate, the base layer and the outgoing base electrode being formed continuous to each other, only the base layer being connected to the first semiconductor layer in a base region; and forming a second semiconductor layer on the base layer.

Claim 16 (Currently amended): A method for fabricating a semiconductor device comprising the steps of:

forming a first semiconductor layer over a semiconductor substrate;
forming an insulation film on the first semiconductor layer;
forming on the insulation film an outgoing base electrode with an opening reaching to the first semiconductor layer formed on a first semiconductor layer formed on a semiconductor substrate;
forming a base layer of silicon germanium containing carbon at least in the opening, the base layer covering a side surface of the outgoing base electrode;
forming a second semiconductor layer on the base layer, and
further comprising the step of implanting a dopant in the interface between the base layer and the outgoing base electrode.

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Claim 17 (Currently amended): A method for fabricating a semiconductor device comprising the steps of:

forming an outgoing base electrode with an opening formed [[on]] over a first semiconductor layer formed [[on]] over a semiconductor substrate; [[and]]

forming a base layer of silicon germanium containing carbon at least in the opening, the base layer covering a side surface of the outgoing base electrode; and

forming a second semiconductor layer on the base layer,

wherein the step of forming the base layer includes the step of forming a carbon-content silicon germanium layer in the opening and [[on]] over the outgoing base electrode; the step of burying a mask material in the opening with the carbon-content silicon germanium layer with the mask material as a mask, and

further comprising the step of implanting a dopant in the interface between the base layer and the outgoing base electrode.

Claim 18 (Currently amended): A method for fabricating a semiconductor device comprising the steps of:

forming a base layer of silicon germanium containing carbon and an outgoing base electrode connected to the base layer [[on]] over a first semiconductor layer formed [[on]] over a semiconductor substrate, the base layer and the outgoing base electrode being formed continuous to each other;

forming a second semiconductor layer on the base layer, and

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further comprising the step of implanting a dopant in the interface between the base layer and the outgoing base electrode.

Claim 19 (Original): A method for fabricating a semiconductor device according to claim 16, wherein

in the step of implanting a dopant, the dopant is implanted obliquely to the surface of the semiconductor substrate.

Claim 20 (Original): A method for fabricating a semiconductor device according to claim 17, wherein

in the step of implanting a dopant, the dopant is implanted obliquely to the surface of the semiconductor substrate.

Claim 21 (New): A semiconductor device according to claim 1 wherein
the base layer is formed by implanting an impurity into a portion of the base layer.